ELSEVIER

Volume 255, Numbers 1–2, 15 January 1995

thin solid films

Contents

Preface xi

Sponsors xiii

Porous Silicon: Preparation

The physics of macroporous silicon formation 1
V. Lehmann (München, Germany)

Influence of the formation conditions on the microstructure of porous silicon layers studied by spectroscopic ellipsometry 5
U. Rossow, U. Frotscher (Berlin, Germany), M. Thönissen, M. G. Berger, S. Frohnoff, H. Münder (Jülich, Germany) and W. Richter (Berlin, Germany)

Preparation of porous silicon films by laser ablation 9
R. Laiho and A. Pavlov (Turku, Finland)

Electrical and Transport Properties of Porous Silicon

The electrical properties of porous silicon produced from n^+ silicon substrates 12
A. J. Simons, T. I. Cox, M. J. Uren and P. D. J. Calcott (Great Malvern, UK)

Post-treatment effects on electrical conduction in porous silicon 16
F. Möller, M. Ben Chorin and F. Koch (Garching, Germany)

Resistivity of porous silicon: a surface effect 20
V. Lehmann, F. Hofmann (Munich, Germany), F. Möller and U. Grüning (Garching, Germany)

Photocarrier grating technique in mesoporous silicon 23
R. Schwarz, F. Wang, M. Ben-Chorin, S. Grebner, A. Nikolov and F. Koch (Garching, Germany)

Luminescence Mechanisms I

Theoretical descriptions of porous silicon 27
C. Delerue, M. Lannoo, G. Allan and E. Martin (Lille, France)

On the origin of the porous silicon luminescence 35
J. Zeman, M. Zigone, G. Martinez (Grenoble, France), G. L. J. A. Rikken (Eindhoven, Netherlands), P. Bordet and J. Chenavas (Grenoble, France)

The influence of the spatial structure on the electronic properties of porous silicon: quantum chemical study 39
J. L. Gavartin, C. C. Matthai and I. Morrison (Cardiff, UK)

Electroluminescence

Electroluminescence from n^+-type porous silicon contacted with layer-by-layer deposited polyaniline 43
A. Bsiesy (Saint Martin d'Hères, France), Y. F. Nicolau, A. Ermolieff (Grenoble, France), F. Muller and F. Gaspard (Saint Martin d'Hères, France)

Electroluminescence from porous silicon metal deposition into the pores 49
P. Steiner, F. Kozlowski and W. Lang (Munich, Germany)

Porous Silicon Applications

Micromachining applications of porous silicon 52
P. Steiner and W. Lang (Munich, Germany)

Formation techniques for porous silicon superlattices 59
St. Frohnhoff, M. G. Berger, M. Thönissen, C. Dieker, L. Vescan, H. Münder and H. Lüth (Jülich, Germany)

Elsevier Science S.A.

Electrodeposition of metals into porous silicon 63
M. Jeske, J. W. Schultze (Düsseldorf, Germany), M. Thönissen and H. Münder (Jülich, Germany)

Dynamics of the Porous Silicon Photoluminescence

Recombination dynamics in porous silicon 67
P. Lorenzo, M. Ceschini (Trento, Italy) and H. E. Roman (Hamburg, Germany)

Free-carrier absorption and luminescence decay of porous silicon 70
V. Grivickas and J. Linnros (Kista-Stockholm, Sweden)

Relaxation mechanisms of electronic excitation in nanostructures of porous silicon 74
Th. Dittrich (Berlin, Germany), P. K. Kashkarov, E. A. Konstantinova and V. Yu. Timoshenko (Moscow, Russian Federation)

Picosecond dynamics of photoexited carriers in free standing porous silicon 77
F. Trojánek, P. Malý, I. Pelant, A. Hospodková, V. Kohlová and J. Valenta (Prague, Czech Republic)

Luminescence Mechanisms II

Voltage-induced modifications of porous silicon luminescence 80
A. Bsiesy, F. Gaspard, R. Herino, M. Ligeon, F. Muller, R. Romestain and J. C. Vial (Saint Martin d'Hères, France)

In situ luminescence and IR study of porous silicon during and after anodic oxidation 87
V. M. Dubin, F. Ozanam and J.-N. Chazalviel (Palaiseau, France)

On the possible origin of the photoluminescence from oxidised nanocrystalline silicon 92
H. Tamura, M. Rückschloss, T. Wirschem and S. Vepřek (Munich, Germany)

Other Light Emitting Structures

Growth and luminescence of n-type porous polycrystalline silicon 96
P. Joubert, A. Abouliatim, P. Guyader, D. Briand, B. Lambert and M. Guendouz (Lannion, France)

Photoluminescence from anodized and thermally oxidized porous germanium 99
S. Miyazaki, K. Sakamoto, K. Shiba and M. Hirose (Hiroshima, Japan)

Luminescence of spark-processed materials 103
M. H. Ludwig, R. E. Hummel and M. Stora (Gainesville, FL, USA)

Luminescence enhancement by electrochemical etching of SiC(6H) 107
V. Petrova-Koch (Garching, Germany), O. Sreseli (St. Petersburg, Russian Federation), G. Polisski (Garching, Germany), D. Kovalev (St. Petersburg, Russian Federation), T. Muschik and F. Koch (Garching, Germany)

Porous Silicon Characterization

Modulated photothermal reflectance on porous silicon 111
G. Amato, L. Boarino, G. Benedetto and R. Spagnolo (Torino, Italy)

Characterization of supercritically dried porous silicon 115
St. Frohnhoff, R. Arens-Fischer (Jülich, Germany), T. Heinrich, J. Fricke (Würzburg, Germany), M. Arntzen and W. Theiss (Aachen, Germany)

Investigations of porous Si grains by optical spectroscopy 119
S. Guha (Washington, DC, USA), P. Steiner, F. Kozlowski and W. Lang (Munich, Germany)

Analysis of the surfaces structure in porous Si 123
M. Schoisswohl, H. J. von Bardeleben, V. Morazzani, A. Grosman, C. Ortega (Paris, France), St. Frohnhoff, M. G. Berger and H. Münder (Jülich, Germany)

Structural study of porous silicon 128
S. C. Bayliss, D. A. Hutt, Q. Zhang, P. Harris, N. J. Phillips (Leicester, UK) and A. Smith (Warrington, UK)

Variations in the lattice parameter of porous silicon produced by wetting and vapour adsorption 132
G. Dolino and D. Bellet (Saint Martin d'Hères, France)

Capillary and Van der Waals forces and mechanical stability of porous silicon 135
U. Grüning and A. Yelon (Montréal, Que., Canada)

Anisotropic and polarization effects in Raman scattering in porous silicon 139
I. Gregora (Prague, Czech Republic), B. Champagnon, L. Saviot and Y. Monin (Villeurbanne, France)

Photoluminescence Characterization

Slow luminescence from trapped charges in oxidized porous silicon 143
A. Kux, D. Kovalev and F. Koch (Garching, Germany)

Optical second-harmonic generation studies of the structure of porous silicon surfaces 146
M. Cavanagh, J. R. Power, J. F. McGilp (Dublin, Ireland), H. Münder and M. G. Berger (Jülich, Germany)

Influence of the oxidation process on the luminescence of HF-treated porous silicon 149
Th. Dittrich, H. Flietner (Berlin, Germany), V. Yu. Timoshenko and P. K. Kashkarov (Moscow, Russian Federation)

Porous Silicon and Related Materials (Poster Session)

Porous silicon obtained by anodization in the transition regime 152
M. Bertolotti, F. Carassiti, E. Fazio, A. Ferrari, S. La Monica, S. Lazarouk, G. Liakhou, G. Maiello, E. Proverbio and L. Schirone (Roma, Italy)

Acoustic microscopy investigation of porous silicon 155
R. J. M. Da Fonseca, J. M. Saurel, A. Foucaran, E. Massone, T. Taliercio and J. Camassel (Montpellier, France)

Electron powder ribbon polycrystalline silicon plates used for porous layers fabrication 159
Y. Kolic, R. Gauthier, M. A. Garcia Perez, A. Sibai, J. C. Dupuy, P. Pinard (Villeurbanne, France), R. M'Ghaieth and H. Maaref (Monastir, Tunisia)

Defects in luminescent and non-luminescent porous Si 163
M. Schoisswohl, H. J. von Bardeleben (Paris, France), V. Bratus (Kiev, Ukraine) and H. Münder (Jülich, Germany)

The correlation between structural and optical properties of luminescent porous silicon 167
S. Gardelis, U. Bangert and B. Hamilton (Manchester, UK)

Positron lifetime spectroscopy of n-type and p-type porous silicon 171
S. Dannefaer (Winnipeg, MB, Canada), T. Bretagnon, A. Foucaran, T. Taliercio (Montpellier, France) and D. Kerr (Winnipeg, MB, Canada)

Structural and elastic properties of porous silicon 174
C. C. Matthai, J. L. Gavartin (Cardiff, UK) and A. A. Cafolla (Dublin, Ireland)

Connecting microscopic and macroscopic properties of porous media: choosing appropriate effective medium concepts .. 177
W. Theiß, S. Henkel and M. Arntzen (Aachen, Germany)

Depth profiling of porous silicon layers by attenuated total reflection spectroscopy 181
W. Theiß, M. Wernke and V. Offermann (Aachen, Germany)

Excitation mechanism of porous silicon luminescence: the role of sensitizers 185
I. A. Buyanova, N. E. Korsunskaya, A. U. Savchuk, M. K. Sheinkman (Kiev, Ukraine) and H. J. von Bardeleben (Paris, France)

Simultaneous microphotoluminescence and micro-Raman scattering in porous silicon 188
Y. Monin, L. Saviot, B. Champagnon, C. Esnouf (Villeurbanne, France) and A. Halimaout (Meylan, France)

Correlation between the photoluminescence and chemical bonding in porous silicon 191
D. Dimova-Malinovska, M. Sendova-Vassileva, Ts. Marinova, V. Krastev, M. Kamenova and N. Tzenov (Sofia, Bulgaria)

Optical and electrical properties of porous silicon and stain-etched films 196
E. V. Astrova, S. V. Belov, A. A. Lebedev, A. D. Remenjuk and Yu. V. Rud (St. Petersburg, Russian Federation)

Fourier transform IR monitoring of porous silicon passivation during post-treatments such as anodic oxidation and contact with organic solvents 200
M. A. Hory, R. Hérino, M. Ligeon, F. Muller, F. Gespard, I. Mihalcescu and J. C. Vial (Saint Martin D'Hères, France)

Time and temperature evolution of light emission from porous silicon prepared from p^- and p^+ substrates 204
G. Amato (Turin, Italy), G. Di Francia and P. Menna (Naples, Italy)

Low-temperature fatigue of photoluminescence in aged porous silicon 208
V. Grivickas, J. Linnros and J. A. Tellefsen (Kista-Stockholm, Sweden)

Anomalous luminescence degradation behaviour of chemically oxidized porous silicon 212
R. Czaputa, R. Fritzl and A. Popitsch (Graz, Austria)

Temperature dependence of radiative and non-radiative transitions in porous silicon 216
T. Tsuboi (Kyoto, Japan), R. Laiho and A. Pavlov (Turku, Finland)

Comparison of anodically etched porous silicon with spark-processed silicon 219
R. E. Hummel, M. Ludwig, S.-S. Chang and G. LaTorre (Gainesville, FL, USA)

Influence of rapid thermal oxidation on differently prepared porous silicon..... 224
W. Lang, P. Steiner, F. Kozlowski and P. Ramm (Munich, Germany)

Natural oxidation of annealed chemically etched porous silicon..... 228
N. Hadj Zoubir, M. Vergnat (Vandœuvre-lès-Nancy, France), T. Delatour, A. Burneau (Villers-lès-Nancy, France), Ph. de Donato and O. Barrès (Vandœuvre-lès-Nancy, France)

Homogeneous chemical etching of sandblasted silicon substrates 231
M. Vergnat, N. Hadj Zoubir and A. Burneau (Vandœuvre-lès-Nancy, France)

Urbach edges in light-emitting porous silicon and related materials..... 234
E. Bustarret (Grenoble, France), M. Ligeon, I. Mihalcescu (Saint Martin d'Hères, France) and J. Oswald (Prague, Czech Republic)

Influence of molecule adsorption on porous silicon photoluminescence..... 238
Th. Dittrich (Berlin, Germany), E. A. Konstantinova and V. Yu. Timoshenko (Moscow, Russian Federation)

Correlation between the luminescence and Raman peaks in quantum-confined systems..... 214
P. Déak, Z. Hajnal (Budapest, Hungary), M. Stutzmann (München, Germany) and H. D. Fuchs (Stuttgart, Germany)

The relation between the visible and the infrared luminescence bands in porous silicon. Comparison with amorphous Si alloys..... 246
V. Petrova-Koch and T. Muschik (Garching, Germany)

Resonantly excited photoluminescence in porous silicon..... 250
M. Rosenbauer, D. H. Leach (Stuttgart, Germany), M. Sendonva-Vassileva (Sofia, Bulgaria), S. Finkbeiner (Stuttgart, Germany) and M. Stutzmann (Garching, Germany)

Interpretation of the temperature dependence of the strong visible photoluminescence in porous silicon..... 254
S. Finkbeiner and J. Weber (Stuttgart, Germany)

Electrical behaviour of aluminium–porous silicon junctions 258
D. Deresmes, V. Marissael, D. Stievenard (Lille, France) and C. Ortega (Paris, France)

A lateral injection porous silicon device structure for light-emitting diodes 262
C. C. Yeh, C. H. Lee, H. L. Hwang and K. Y. J. Hsu (Hsinchu, Taiwan)

Investigation of electrical properties of Au/porous Si/Si structures..... 266
M. Ádám, Zs. J. Horváth, I. Bársony (Budapest, Hungary), L. Szölgyémy (Eldoret, Kenya), E. Vázsonyi and V. V. Tuyen (Budapest, Hungary)

Photoconductivity study of self-supporting porous silicon 269
R. Sedlačík, F. Karel, J. Oswald, A. Fejfar, I. Pelant and J. Kočka (Prague, Czech Republic)

Influence of humidity on transport in porous silicon..... 272
J. J. Mareš, J. Krištofik and E. Hulicius (Praha, Czech Republic)

Electronic properties and Schottky barrier of porous silicon–Au interface..... 276
R. Laiho and A. Pavlov (Turku, Finland)

Luminescence of porous multicrystalline $Si_{1-x}Ge_x$ alloys 279
Y. Kolic, E. Borne, M. A. Garcia Perez, A. Sibai, R. Gauthier and A. Laugier (Villeurbanne, France)

Structural and luminescence studies of stain-etched and electrochemically etched germanium..... 282
M. Sendova-Vassileva, N. Tzenov, D. Dimova-Malinovska (Sofia, Bulgaria), M. Rosenbauer (Stuttgart, Germany), M. Stutzmann (Garching, Germany) and K. V. Josepovits (Budapest, Hungary)

Luminescence from a Si–SiO_2 nanocluster-like structure prepared by laser ablation 286
L. A. Movtchan, R. W. Dreyfus, W. Marine, M. Sentis, M. Autric, G. Le Lay (Marseille, France) and N. Merk (Lausanne, Switzerland)

Low temperature UV oxidation of SiGe for preparation of Ge nanocrystals in SiO_2..... 290
V. Craciun (London, UK), A. H. Reader (Crolles, France), D. E. W. Vandenhoudt (Eindhoven, Netherlands), S. Best, R. S. Hutton (London, UK), A. Andrei (Pitesti, Romania) and I. W. Boyd (London, UK)

Light emission from recrystallized amorphous Si MQW structures 295
E. F. Steigmeier, D. Grützmacher, H. Auderset, R. Morf, B. Delley and R. Wessicken (Zurich, Switzerland)

Photoluminescent properties of porous films of tantalum silicides 298
V. P. Parkhutik and J. M. Martinez-Duart (Madrid, Spain)

Light-emitting Si prepared by laser annealing of a-Si:H 302
K. M. A. El-Kader, I. Ulrych, V. Cháb, J. Oswald, P. Kubát, P. Engst, J. Stuchlík, A. Fejfar, R. Černý, I. Pelant and J. Kočka (Prague, Czech Republic)

Luminescence properties of plasma-treated silicon surfaces 305
D. Rüter, S. Rolf, W. Bauhofer (Hamburg, Germany), P. J. Klar and D. Wolverson (Norwich, UK)

Realization of porous silicon membranes for gas sensor applications 310
T. Taliercio (Montpellier, France), M. Dilhan (Blagnac, France), E. Massone (Montpellier, France), A. M. Gué (Toulouse, France), B. Fraisse and A. Foucaran (Montpellier, France)

Investigation and design of optical properties of porosity superlattices 313
M. G. Berger, M. Thönissen, R. Arens-Fischer, H. Münder, H. Lüth (Jülich, Germany), M. Arntzen and W. Theiß (Aachen Germany)

Deposition of electrically conducting polybithiophene into porous silicon 317
K. G. Jung, J. W. Schultze (Düsseldorf, Germany), M. Thönissen and H. Münder (Jülich, Germany)

P wells made of porous silicon for power devices: determination of the formation steps 321
P. Déhu, A. Senes (Nanterre, France) and F. Miserey (Paris, France)

Photocurrent collection in porous semiconductor structures 325
M. C. Rossi, R. Vincenzoni (Rome, Italy) and F. Galluzzi (Messina, Italy)

Sub-micrometre luminescent porous silicon structures using lithographically patterned substrates 329
A. G. Nassiopoulos, S. Grigoropoulos (Demokritos, Greece), L. Canham (Malvern, UK), A. Halimaoui (Grenoble, France), I. Berbezier (Marseille, France), E. Gogolodos and D. Papadimitriou (Athens, Greece)

Author Index 335

Subject Index 337